

CLAIMS

1. A collective screen for a rear projection multi-screen display device comprising a plurality of unit screens having at
5 least two types of lengths in a direction of thickness of the screen, with front end surfaces or optical image output faces thereof joined together flush with each other without any clearance therebetween, wherein the collective screen is provided with a single continuous collective optical image
10 output face, the unit screens of different lengths are disposed to be adjacent to each other, each of the unit screens is provided with a plurality of optical fibers which have the same length within the range of 5 mm to 100 cm and are integrally joined together so that at least front ends and rear ends
15 thereof are aligned substantially in radial contact with each other, and a rear end surface of each of the unit screens constitutes an optical image input face.

2. The collective screen for a rear projection multi-screen display device according to claim 1, wherein: the
20 plurality of unit screens include two types of a short unit screen and a long unit screen which is longer by at least 1 cm or more than the short unit screen in the direction of thickness of the screen, and the optical image output faces of the short unit screens and the optical image output faces of
25 the long unit screens are disposed in a staggered arrangement on the collective optical image output face.

3. The collective screen for a rear projection multi-screen display device according to claim 1 or 2, wherein the optical image input face of the long unit screen is surrounded
30 by a mask member for shielding any leakage light of an optical image out of the optical image input face of the long unit

screen, the optical image being projected onto the optical image input face.

4. The collective screen for a rear projection multi-screen display device according to claim 1, 2 or 3, wherein an
5 antireflective coating is applied to an outer circumferential surface of the long unit screen adjacent to the optical image input face of the short unit screen in a range of at least 5 mm from the optical image input face of the short unit screen towards the rear end thereof.

10 5. The collective screen for a rear projection multi-screen display device according to any one of claims 1 to 4, comprising a support frame for restraining at least an outer circumference of the long unit screen near the optical image input face to support the long unit screen.

15 6. The collective screen for a rear projection multi-screen display device according to claim 5, wherein the support frame is configured to shield any leakage light of an optical image out of the optical image input face of the long unit screen, the optical image being projected onto the optical
20 image input face.

7. The collective display screen according to any one of claims 1 to 6, comprising a collective screen support framework for surrounding the single continuous collective optical image output face and securely restraining a front-end outer
25 circumference of the unit screens bundled to constitute the collective optical image output face.

8. The collective screen for a rear projection multi-screen display device according to claim 5 or 6, comprising a collective screen support framework for surrounding the single
30 continuous collective optical image output face and securely restraining a front-end outer circumference of the unit screens

bundled to constitute the collective optical image output face, and the collective screen support framework is provided integrally with the support frame.

5 9. The collective screen for a rear projection multi-screen display device according to any one of claims 1 to 8, wherein the optical fiber has a quadrangular rear end surface, and the optical image input face of the unit screen is formed in a quadrangular shape with the quadrangular rear end surfaces joined together.

10 10. The collective screen for a rear projection multi-screen display device according to any one of claims 1 to 8, wherein the optical fibers have a regular hexagonal rear end surface and are closely joined together for these regular hexagonal shapes to be formed in a most densely filled
15 arrangement, thereby forming the optical image input face.

11. The collective screen for a rear projection multi-screen display device according to any one of claims 1 to 8, wherein the optical fibers have a circular rear end surface and are closely joined together for these circular shapes to be
20 formed in a most densely filled arrangement, thereby forming the optical image input face.

12. The collective screen for a rear projection multi-screen display device according to any one of claims 1 to 11, wherein the optical fibers have a quadrangular front end
25 surface, and these quadrangular front end surfaces are joined together so as to be disposed with the same pitch in vertical and horizontal directions of the screen, thereby forming the optical image output face.

13. The collective screen for a rear projection multi-screen display device according to any one of claims 1 to 11, wherein the optical fibers have a regular hexagonal front end
30

surface, and these regular hexagonal front end surfaces are joined together for these regular hexagonal shapes to be formed in a most densely filled arrangement, thereby forming the optical image output face.

5 14. The collective screen for a rear projection multi-screen display device according to any one of claims 1 to 11, wherein the optical fibers have a circular front end surface, and these circular front end surfaces are closely joined together for these circular shapes to be formed in a most
10 densely filled arrangement, thereby forming the optical image output face.

 15. The collective screen for a rear projection multi-screen display device according to any one of claims 1 to 11, wherein the optical fibers have a circular front end surface,
15 and these circular shapes are joined together so as to be disposed with the same pitch as a diameter of the circular shape in vertical and horizontal directions of the screen, thereby forming the optical image output face.

 16. The collective screen for a rear projection multi-
20 screen display device according to any one of claims 1 to 15, for use in a rear projection multi-screen wherein the optical fiber has a shape of a hollow core pipe.

 17. The collective screen for a rear projection multi-screen display device according to claim 16, wherein the front
25 end surface of the optical fiber is coated with a black coating layer.

 18. The collective screen for a rear projection multi-screen display device according to claim 16 or 17, wherein the rear end surface of the optical fiber is coated with a black
30 coating layer.

 19. The collective screen for a rear projection multi-

screen display device according to any one of claims 1 to 18, wherein the optical fibers constituting the unit screen are formed of either resin or silica.

20. The collective screen for a rear projection multi-
5 screen display device according to claim 16, 17 or 18, wherein the optical fibers constituting the unit screen are formed of a metal channel member with an inner circumferential surface of a hollow core serving as a reflective face.

21. The collective screen for a rear projection multi-
10 screen display device according to claim 20, wherein the metal channel member is formed of a thin metal plate which is bent into a generally rectangular waveform so as to have inner hollow cores and allow the cores to be disposed successively.

22. The collective screen for a rear projection multi-
15 screen display device according to claim 21, wherein the thin metal plate is corrugated, and a plurality of the thin metal plates are joined together one on another in a direction of thickness so as to close the hollow cores, to constitute the unit screens.

20 23. The collective screen for a rear projection multi-screen display device according to claim 22, wherein the thin metal plate is formed to provide successive quadrangular cross sections, and two of the quadrangular cross sections are opposed to each other to form a quadrangle of a doubled cross-
25 sectional area as a core.

24. The collective screen for a rear projection multi-screen display device according to claim 23, wherein the thin metal plate is formed to have successive trapezoidal cross sections, and two of the trapezoidal cross sections are opposed
30 to each other to form a hexagonal core.

25. The collective screen for a rear projection multi-

screen display device according to claim 21, wherein: the thin metal plate is corrugated; the thin metal plate is connected with a thin right flat reinforcing metal plate to close the quadrangular cross sections and thus form closed quadrangular cross sections disposed successively side by side; and the corrugated thin metal plate and the reinforcing thin metal plate are joined together one on the other in a direction of thickness, thereby forming the unit screens.

26. The collective screen for a rear projection multi-screen display device according to any one of claims 21 to 25, wherein the inner circumferential surface of the hollow core of the optical fiber is tapered near an end face of the optical fiber to be increased in inner diameter toward the end face and to form an edge on which the metal channel member has a material thickness of 0.05 mm or less on the end face.

27. The collective screen for a rear projection multi-screen display device according to any one of claims 1 to 19, wherein an outer circumferential surface of an end portion of the optical fiber is coated with a black coating layer in a range of at least 3 mm from the end face of the optical fiber.

28. The collective screen for a rear projection multi-screen display device according to claim 27, for use in a rear projection multi-screen wherein the black coating layer which coats the outer circumferential surface of the end portion of the optical fiber is formed of an adhesive for securely adhering the end portion of the optical fiber in a direction of a diameter thereof.

29. The collective screen for a rear projection multi-screen display device according to any one of claims 1 to 28, wherein the rear end surface or the optical image input face of the unit screen is concave spherical.

30. A rear projection multi-screen display device,
comprising:

a collective screen for serving as a single continuous
collective optical image output face, the collective screen
5 having front end surfaces or optical image output faces of a
plurality of unit screens being collectively joined together
flush with each other without any clearance therebetween, the
plurality of unit screens having at least two types of lengths
in a direction of thickness of the screen; and

10 projectors which are the same in number as the unit
screens and disposed behind the collective screen corresponding
respectively to the unit screens, the projector projecting an
optical image onto a rear end surface or an optical image input
face of the corresponding unit screen, wherein

15 the collective screen has the unit screens of different
lengths disposed adjacent to each other, and

each of the unit screens is provided with a plurality of
optical fibers which have the same length in a range of 5 mm to
100 cm and are integrally joined together so that at least
20 front ends and rear ends thereof are aligned substantially in
radial contact with each other.

31. The rear projection multi-screen display device
according to claim 30, wherein: the plurality of unit screens
include two types of a short unit screen and a long unit screen
25 which is longer by at least 1 cm or more than the short unit
screen in the direction of thickness of the screen, and the
optical image output faces of the short unit screens and the
optical image output faces of the long unit screens are
disposed in a staggered arrangement on the collective optical
30 image output face.

32. The rear projection multi-screen display device

according to claim 30 or 31, wherein the optical image input face of the long unit screen is surrounded by a mask member for shielding any leakage light of an optical image out of the optical image input face of the long unit screen, the optical
5 image being projected onto the optical image input face.

33. The rear projection multi-screen display device according to claim 30, 31 or 32, wherein an antireflective coating is applied to an outer circumferential surface of the long unit screen adjacent to the optical image input face of
10 the short unit screen in a range of at least 5 mm from the optical image input face of the short unit screen towards the rear end thereof.

34. The rear projection multi-screen display device according to any one of claims 30 to 33, comprising a support
15 frame for restraining at least an outer circumference of the long unit screen near the optical image input face to support the long unit screen.

35. The rear projection multi-screen display device according to claim 34, wherein the support frame is configured
20 to protrude toward the projector with respect to the optical image input face of the long unit screen and to shield any leakage light of a projected optical image out of the optical image input face.

36. The rear projection multi-screen display device
25 according to claim 34 or 35, wherein a Fresnel lens is attached to each of the support frames associated with the respective unit screens between the projector and the optical image input face of the unit screen associated therewith, the Fresnel lens slightly diverging or generally collimating an optical image
30 projected from the projector.

37. The rear projection multi-screen display device

according to any one of claims 30 to 36, wherein the optical image input face of the unit screen is concave spherical, and a center of optical image emission of the projector is disposed near a center of the concave spherical surface.

5 38. The rear projection multi-screen display device according to any one of claims 30 to 35 and 37, wherein a Fresnel lens is provided to each of the unit screens between the projector and the optical image input face of the unit screen associated therewith, the Fresnel lens slightly
10 diverging or collimating an optical image diverged when projected from the projector.

 39. The rear projection multi-screen display device according to any one of claims 30 to 38, comprising a collective screen support framework for surrounding and
15 securing an outer circumference of the unit screens integrated into one piece to constitute the collective optical image output face.

 40. The rear projection multi-screen display device according to claim 34 or 35, wherein a collective screen
20 support framework for surrounding and securing a front-end outer circumference of the unit screens integrated into one piece to constitute the collective optical image output face is integrated with the support frames.

 41. The rear projection multi-screen display device
25 according to any one of claims 30 to 40, wherein the optical fiber has a quadrangular rear end surface, and the optical image input face of the unit screen is formed in a quadrangular shape with the quadrangular rear end surfaces joined together.

 42. The rear projection multi-screen display device
30 according to claim 41, wherein the optical fiber has a regular quadrangular rear end surface.

43. The rear projection multi-screen display device according to any one of claims 30 to 42, wherein the projector is designed to project a beam of light quadrangular in cross section while scanning across the optical image input face.

5 44. The rear projection multi-screen display device according to any one of claims 30 to 40, wherein the optical fibers have a hexagonal rear end surface and are closely joined together for these hexagonal shapes to be formed in a most densely filled arrangement, thereby forming the optical image
10 input face.

 45. The rear projection multi-screen display device according to any one of claims 30 to 40, wherein the optical fibers have a circular rear end surface and are closely joined together for these circular shapes to be formed in a most
15 densely filled arrangement, thereby forming the optical image input face.

 46. The rear projection multi-screen display device according to any one of claims 40 to 45, wherein the optical fibers have a quadrangular front end surface, and these
20 quadrangular front end surfaces are joined together so as to be disposed with the same pitch in vertical and horizontal directions of the screen, thereby forming the optical image output face.

 47. The rear projection multi-screen display device
25 according to any one of claims 30 to 45, wherein the optical fibers have a regular hexagonal front end surface, and these regular hexagonal front end surfaces are joined together for these regular hexagonal shapes to be formed in a most densely filled arrangement, thereby forming the optical image output
30 face.

 48. The rear projection multi-screen display device

according to any one of claims 30 to 47, wherein the optical fibers have a circular front end surface, and these circular front end surfaces are closely joined together for these circular shapes to be formed in a most densely filled arrangement, thereby forming the optical image output face.

49. The rear projection multi-screen display device according to any one of claims 30 to 47, wherein the optical fibers have a circular front end surface, and these circular shapes are joined together so as to be disposed with the same pitch in vertical and horizontal directions of the screen, thereby forming the optical image output face.

50. The rear projection multi-screen display device according to any one of claims 30 to 49, for use in a rear projection multi-screen wherein the optical fiber has a shape of a hollow core pipe.

51. The rear projection multi-screen display device according to claim 50, wherein the front end surface of the optical fiber is coated with a black coating layer.

52. The rear projection multi-screen display device according to claim 50 or 51, wherein the rear end surface of the optical fiber is coated with a black coating layer.

53. The rear projection multi-screen display device according to any one of claims 30 to 52, wherein the optical fibers constituting the unit screen are formed of either resin or silica.

54. The rear projection multi-screen display device according to claim 50, 51 or 52, wherein the optical fibers constituting the unit screen are formed of a metal channel member with an inner circumferential surface of a hollow core serving as a reflective face.

55. The rear projection multi-screen display device

according to claim 54, wherein the metal channel is formed of a thin metal plate which is bent into a rectangular waveform so that quadrangular cross sections with an inner hollow core are successively formed.

5 56. The rear projection multi-screen display device according to claim 54, wherein the thin metal plate is corrugated, and a plurality of the thin metal plates are joined together one on another in a direction of thickness so as to close the hollow cores, to constitute the unit screens.

10 57. The rear projection multi-screen display device according to claim 55, wherein the thin metal plate is formed to provide successive quadrangular cross sections, and two of the quadrangular cross sections are opposed to each other to form a quadrangle of a doubled cross-sectional area as a core.

15 58. The rear projection multi-screen display device according to claim 57, wherein the thin metal plate is formed to have successive trapezoidal cross sections, and two of the trapezoidal cross sections are opposed to each other to form a hexagonal core.

20 59. The rear projection multi-screen display device according to claim 54, wherein: the thin metal plate is corrugated; the thin metal plate is connected with a thin right flat reinforcing metal plate to close the quadrangular cross sections and thus form closed quadrangular cross sections
25 disposed successively side by side; and the corrugated thin metal plate and the reinforcing thin metal plate are joined together one on the other in a direction of thickness, thereby forming the unit screens.

30 60. The rear projection multi-screen display device according to any one of claims 54 to 59, wherein the inner circumferential surface of the hollow core of the optical fiber

is tapered near an end face of the optical fiber to be increased in inner diameter toward the end face and to form an edge on which the metal channel member has a material thickness of 0.05 mm or less on the end face.

5 61. The rear projection multi-screen display device according to any one of claims 30 to 60, wherein an outer circumferential surface of an end portion of the optical fiber is coated with a black coating layer in a range of at least 3 mm from the end face of the optical fiber.

10 62. The rear projection multi-screen display device according to claim 61, wherein the black coating layer which coats the front-end outer circumferential surface of the optical fiber is formed of an adhesive for securely adhering the front end portion of the optical fiber in a direction of a
15 diameter thereof.

 63. The rear projection multi-screen display device according to any one of claims 30 to 60, wherein the rear end surface or the optical image input face of the unit screen is concave spherical.

20 64. An optical fiber for a collective screen, comprising a metal channel member, wherein the metal channel member has a hollow core center portion and is either quadrangular or hexagonal in a cross-sectional outer circumference shape and the hollow core shape.

25 65. The optical fiber for collective screens according to claim 64, wherein each of the cross-sectional outer circumference shape and the hollow core shape is square.

 66. An optical fiber for a collective screen, comprising a metal channel member, wherein the metal channel member has a
30 hollow core center portion and is regular hexagonal in a cross-sectional outer circumference shape and the hollow core shape.

67. The optical fiber for collective screens according to any one of claims 64 to 66, wherein the inner circumferential surface of the hollow core of the optical fiber is tapered near a rear end face of the optical fiber to be increased in inner diameter toward the rear end face and to form an edge on which the metal channel member has a material thickness of 0.05 mm or less on the end face.

68. The optical fiber for collective screens according to any one of claims 64 to 67, wherein a rear end surface of the metal channel member is coated with a black coating layer.

69. The optical fiber for collective screens according to any one of claims 61 to 68, wherein a front end surface of the metal channel member is coated with a black coating layer.

70. A flat optical fiber prepared by disposing a plurality of the optical fibers for a collective screen according to any one of claims 61 to 69 side by side to be integrally formed in a shape of a belt.

71. A flat optical fiber comprising a thin metal plate which is bent into a quadrangular waveform so that quadrangular cross sections are successively formed, wherein a plurality of hollow optical fibers with each of the quadrangular cross sections having a hollow core are disposed side by side and integrally formed in a shape of a belt.

72. The flat optical fiber according to claim 71, wherein the thin metal plate is corrugated to be connectable one on another in a direction of thickness so as to close the hollow core.

73. The flat optical fiber according to claim 72, wherein the thin metal plate is formed to provide successive quadrangular cross sections, and two of the quadrangular cross sections are opposed to each other to form a quadrangle of a

doubled cross-sectional area as a core.

74. The flat optical fiber according to claim 73, wherein the thin metal plate is formed to have successive trapezoidal cross sections, and two of the trapezoidal cross sections are
5 opposed to each other to form a hexagonal core.

75. The flat optical fiber according to claim 71, wherein: the thin metal plate is corrugated; the thin metal plate is connected with a thin right flat reinforcing metal plate to close the quadrangular cross sections and thus form
10 closed quadrangular cross sections disposed successively side by side.